

## Advanced Electric Propulsion NextSTEP BAA Activity

Completed Technology Project (2015 - 2018)

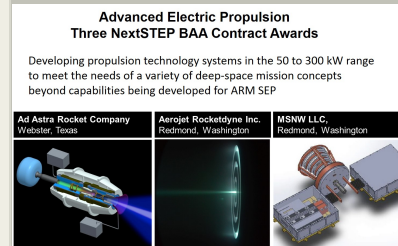


## Project Introduction

The goal of the AES Advanced Electric Propulsion Next Space Technologies for Exploration Partnerships (NextSTEP) Broad Agency Announcement (BAA) activity is to develop and demonstrate high specific impulse (~2000 to ~5000 s range), high efficiency (greater than 60%), and high power (50 to 300 kW range) electric propulsion technology for long-duration, deep-space transportation systems. Three companies were awarded fixed price, milestone based contracts to mature and test high power Electric Propulsion (EP) systems to a Technology Readiness Level (TRL) of 5. The intent of these Advanced Propulsion NextSTEP BAA contracts will be to enable a public-private partnership for robust exploration and implementation of opportunities managed by NASA's HEOMD/AES Division.

This work is being led by three companies, Ad Astra, Aerojet Rocketdyne, and MSNW, LLC, that were competitively selected by NASA's HEOMD/AES Division in response to the NextSTEP BAA solicitation in the area of Advanced Propulsion. Each company was awarded a fixed price, milestone achievement based contract, with a one year base period and two one-year options. Also, each company was required as part of their proposal submittal to show a minimum 50% corporate contribution (made within the last five years) that was directly relevant to the Advanced Electric Propulsion NextSTEP BAA Activity. Some of these prior, relevant corporate contributions are shown in the project library. During the third year of these contracts, each contractor will demonstrate a 100 kW EP system for 100 continuous hours (at thermal steady-state). Specifically, Ad Astra will test a Variable Specific Impulse Magnetoplasma Rocket (VASIMR) EP system; Aerojet Rocketdyne will test a Nested Hall Thruster EP system; and MSNW, LCC will test an Electrodeless Lorentz Force (ELF) Thruster EP system.

These technology maturation and demonstration activities are focused on further development of high power EP engine technologies and includes the following objectives to be met by the end of these three year contract efforts:



Three companies leading this effort.

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- The EP engine systems, including its Power Production Units (PPUs), if required, internal thermal control systems, and propellant management systems are to be at least TRL 5.
- The EP engine system must demonstrate a minimum of 100 hours of continuous lifetime testing after reaching TRL 5 with the following operational constraints:
  - Maintain thermal steady state for the full 100 hours
  - Total system input power must be a minimum of 100 kW for the full 100 hours
  - Must be operated with at least TRL 5 PPU(s), if required. If a Direct Drive power system is to be utilized, the EP engine system must be operated with the expected voltage and current profiles. The EP engine system must demonstrate its tolerance and performance with the full range of expected fluctuations in voltage and current.

## Anticipated Benefits

Not applicable to currently funded missions.

High power electric systems in the range of 50 to 300 kW per thruster would significantly enhance or enable a variety of mission concepts that could include Earth-orbiting tugs, Earth-Cislunar tugs, Earth-Mars cargo transfer, Earth-Mars human transfer, and other human space exploration missions.

NASA expects the capabilities and technologies developed through these partnerships to also provide significant commercial benefits, particularly for use in Earth-orbit and Earth-Cislunar space in the near-term.

## Organizational Responsibility

**Responsible Mission Directorate:**

Exploration Systems Development Mission Directorate (ESDMD)

**Lead Center / Facility:**

NASA Headquarters (HQ)

**Responsible Program:**

Exploration Capabilities

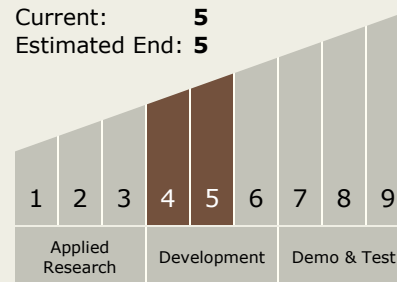
## Project Management

**Program Director:**

Christopher L Moore

## Technology Maturity (TRL)

Start: 4  
Current: 5  
Estimated End: 5



## Technology Areas

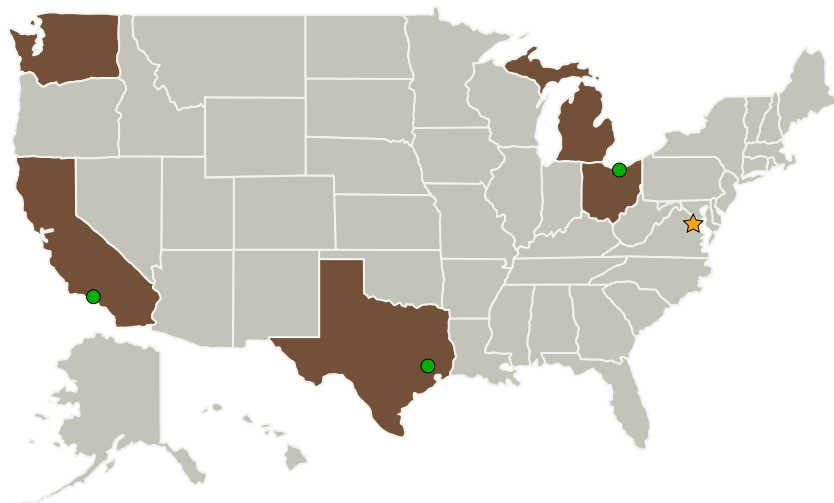
**Primary:**

- TX01 Propulsion Systems

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## Primary U.S. Work Locations and Key Partners



## Technology Areas (cont.)

- └ TX01.1 Chemical Space Propulsion
- └ TX01.1.8 Warm Gas

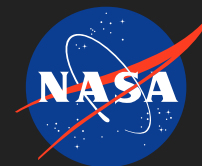
## Target Destinations

The Moon, Mars

## Supported Mission Type

Push

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Organizations Performing Work	Role	Type	Location
★ NASA Headquarters(HQ)	Lead Organization	NASA Center	Washington, District of Columbia
Ad Astra Rocket Company	Supporting Organization	Industry Small Disadvantaged Business (SDB)	
Aerojet Rocketdyne Holdings, Inc.	Supporting Organization	Industry	El Segundo, California
● Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio
● Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California
● Johnson Space Center(JSC)	Supporting Organization	NASA Center	Houston, Texas
MSNW, LLC	Supporting Organization	Industry	Redmond, Washington

Co-Funding Partners	Type	Location
Helion Energy	Industry Small Disadvantaged Business (SDB)	
Silicon Turnkey Solutions	Industry	
University of Michigan-Ann Arbor	Academia	Ann Arbor, Michigan

Primary U.S. Work Locations	
California	District of Columbia
Michigan	Ohio
Texas	Washington



## Project Transitions

-  **October 2015:** Project Start
  -  **December 2018:** Closed out
- Closeout Summary:** Responsibility for this activity will transfer to the Space Technology Mission Directorate in 2019.

## Images



### AES Advanced Electric Propulsion NextSTEP BAA Activity

Three companies leading this effort.  
(<https://techport.nasa.gov/image/34440>)

## Stories

Ad Astra - Development Toward a Spaceflight Capable VASIMR® Engine and SEP Applications  
(<https://techport.nasa.gov/file/47610>)

Ad Astra - Improved Efficiency and Throttling Range of the VX-200 Magnetoplasma Thruster  
(<https://techport.nasa.gov/file/47609>)

Ad Astra - Recent VASIMR Publications  
(<https://techport.nasa.gov/file/47612>)

Ad Astra - VASIMR® Spaceflight Engine System Mass Study and Scaling with Power  
(<https://techport.nasa.gov/file/47611>)

Aerojet Rocketdyne - Affordable Exploration Architectures Using the Space Launch System and High Power Solar Electric Propulsion  
(<https://techport.nasa.gov/file/47615>)

Aerojet Rocketdyne - Affordable Exploration Architectures Using the Space Launch System and High Power Solar Electric Propulsion  
(<https://techport.nasa.gov/file/47616>)

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Aerojet Rocketdyne - Demonstration of the XR-12 Hall Current Thruster  
(<https://techport.nasa.gov/file/47618>)

Aerojet Rocketdyne - Development of a Modular Hall Thruster Power Converter  
(<https://techport.nasa.gov/file/47617>)